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ABSTRACT

This paper reports the results of a five-year case study of the use of online tools: Internet, e-mail, and the World Wide Web, within a Graduate School of Education. The conceptual framework was independently developed, but because of the striking parallel with activity theory, activity theory became the overall framework for interpreting findings. Ten research questions were investigated using multiple surveys; interviews of faculty, staff, and students; a focus group; and an analysis of electronic artifacts. Principle findings include the following: self-efficacy x perceived value persisted across time and across programs as success facilitators; personal/cultural compatibility, rather than time, separated earlier from later adopters; "Finding a voice and having something to say," a factor identified under various names by other researchers, posed a barrier for students and faculty alike; users valued personal scaffolding but had individual preferences concerning specific types of scaffolding. (Contains 19 references, 4 tables, and 1 figure.) (Author/AEF)

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Diffusion of the Internet within a Graduate School

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Abstract

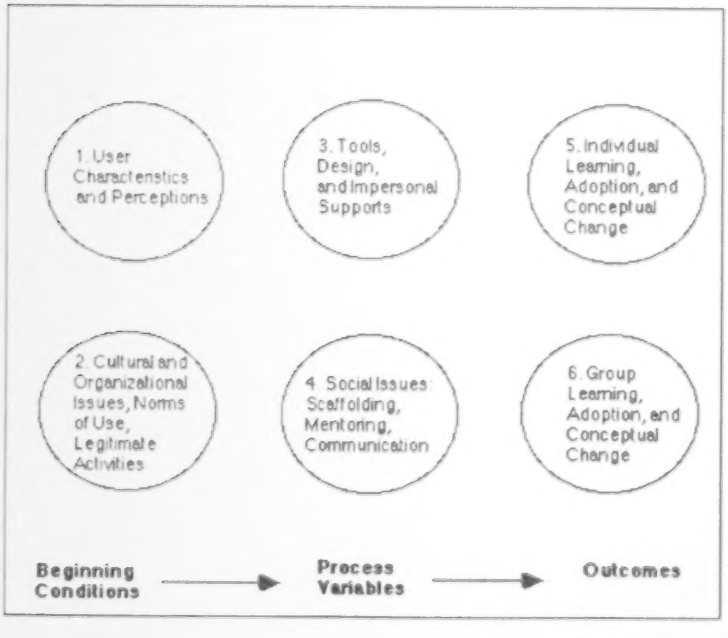
This paper reports the results of a five-year case study of the use of online tools: Internet, e-mail, and the WWW, within a Graduate School of Education. The conceptual framework was independently developed, but because of the striking parallel with activity theory, activity theory became the overall framework for interpreting findings. Ten research questions were investigated using multiple surveys; interviews of faculty, staff, and students; a focus group; and an analysis of electronic artifacts. Principal findings included the following:

- *Self-efficacy x perceived value persisted across time and across programs as success facilitators.*
- *Personal/cultural compatibility, rather than time, separated earlier from later adopters.*
- *"Finding a voice and having something to say", a factor identified under various names by other researchers, posed a barrier for students and faculty alike.*
- *Users valued personal scaffolding but had individual preferences concerning specific types of scaffolding.*

Theory Base

This case study investigated the factors that affect the use of the Internet within a Graduate School of Education (SOE). In this context, "Internet tools" were defined as e-mail, a FirstClass ™ BBS known as Colorado Education On-line (CEO), and the WWW. The study combined both empirical research within the school and an extensive review of relevant literature to identify 28 distinct factors. These factors grouped into six naturally emerging clusters that influence the diffusion of the Internet within the school. (See Figure 1.) These clusters acted as a starting point for formulating a new model of adoption of telecommunications by institutions of higher education.

Figure 1. Clusters of Factors Influencing Diffusion of the Internet


1. User Characteristics and Perceptions
3. Tools, Design, and Impersonal Supports
5. Individual Learning, Adoption, and Conceptual Change
2. Cultural and Organizational Issues, Norms of Use, Legitimate Activities
4. Social Issues: Scaffolding, Mentoring, Communication
6. Group Learning, Adoption, and Conceptual Change
Beginning Conditions
Process Variables
Outcomes

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It is interesting to note the striking parallel between Engestrom's (1996) depiction of an activity system and the process that may be occurring in the SOE regarding the adoption and use of the Internet as the activity under investigation.

A key point in Soviet psychology, attributed to Vygotsky, is the emphasis on the use of tools in the development of human mental processes. "The tool is not simply added on to human activity; rather, it transforms it" (Tikhomirov, 1981: 270). Engestrom expands Vygotsky's notion to conceptualize human activity as an interdependent system that ties the individual to the larger cultural context: "Collective activity is realized through individual actions, but it is not reducible to a sum total of those actions" (Engestrom, 1996: 262).

In Engestrom's conceptual framework, known as an activity system, the activities in which an individual engages tend to connect six elements, namely: (a) the individual actor, (b) the object of action together with an expected outcome, (c) the tools used to carry out the activity, (d) the community of which the actor is a part, (e) the norms and conventions of use of those tools, and (f) the division of labor that characterizes individual actions within local collective activities. These elements are all interrelated; changing one will invariably affect the rest of system. The clusters of factors in Figure 1 can be loosely identified with the six elements of an activity system. This comparison is presented in Table 1.

Table 1. A Comparison of an Activity System and the Six Clusters of Factors That Affect the Diffusion of the Internet

An Activity System	Clusters of Factors That Affect the Diffusion of the Internet
Individual or subject	User characteristics and perceptions
Norms of use, conventions, and rules	Cultural and organizational issues, norms of use, legitimate activities, "vision of learning"
Tools or mediating artifacts	Tools, design, and impersonal supports
Division of labor	Social issues including roles, scaffolding, mentoring, communication
Object or outcome of activity	Individual learning, adoption, conceptual change
Community	Group learning, adoption, conceptual change

Empirical Base

The investigation actually began in the fall of 1994, when an ad hoc group of graduate students, together with their advisor, formed the Internet Task Force. During the 1994-95 academic year, the group attempted to identify facilitators and challenges to Internet use within the Division of Technology and Special Services, which housed the instructional technology master's and doctoral programs (collectively known as "I.T."). Later, the population under surveillance was expanded to include the entire School of Education. The purpose of the study was to articulate the individual conceptual changes and group processes of members of the School of Education as they learn the basics of mediated communication, deal with their concerns and learning anxieties, develop expertise, adopt, and eventually reaffirm or reject the use of the Internet to support teaching and learning.

Building on a prior study of Electronic discussion groups, *Using e-mail as an instructional strategy in a graduate seminar* by Wilson, Lowry, Koneman, and Osman-Jouchoux (1994), members of the Internet Task Force explored two facets of Internet usage: *Affordances and constraints of the Internet for learning and instruction* (Ryder & Wilson, 1996) and *Cultural assimilation of the Internet* (Wilson, Ryder, McCahan, & Sherry, 1996). They also studied *The Dynamics of Collaborative Design* (Sherry & Myers, 1998) and documented the work of the Internet Task Force (Sherry, 1996) as the team created the web page for the School, using the university e-mail system and the WWW to share information and negotiate differences of opinion. All of these documents are available on line.

In spring 1995, one member interviewed representative members of the faculty; two others interviewed a focus group of students; and another member (Sherry, 1997) analyzed the results of a survey of 73 students, faculty, and staff regarding their use of e-mail and the Internet for instructional purposes. Five factors emerged from these various studies: (a) clear benefit and value, (b) self-efficacy, (c) finding a voice and having something to say (also referred to as mediated writing proficiency), (d) personal/cultural compatibility, and (e) proper scaffolding.

The first two factors to emerge from these earlier studies, namely *clear benefit and value*, and *self-efficacy*, were identified by Bandura (1982) under his theory of self-efficacy as a mediator of performance and achievement. "Finding a voice and having something to say" was identified by Berge (1997). It was also identified and explored by Fishman (1997) as written communication apprehension and by Sherry (1998) as *mediated writing proficiency*.

Rogers identified the fourth factor, *personal/cultural compatibility* (compatibility between technology and people's learning styles, self-concepts), as one of the five important user perceptions of an innovation – "the degree

to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters". In this study, compatibility includes school policies and norms of use (Rogers, 1995: 15).

The fifth factor was *proper scaffolding*. In Hall and Hord's (1987) *Stages of Concern* model, proper scaffolding is crucial in the personal-concerns stages of adoption when facilitators should visit more often with potential adopters on a face-to-face basis to offer assistance and encouragement. Scaffolding is also important at the management-concerns stage of adoption when it is important to provide "how to do it" workshops that address the constantly changing task issues as they arise (Hall & Hord, 1987: 72).

Two years later (spring 1997), the current study began. The survey was repeated with the same instrument and a stratified sampling of 278 students, faculty, and staff throughout the School of Education. At the same time, a factor analysis was performed on both the 1995 and 1997 surveys to investigate changes in trends over time. Sherry (1998) also repeated the focus group and interviews in spring 1998 using a purposeful selection of students, faculty, and staff, comprising early adopters, early/late majority, and resisters or "laggards". (See Rogers, 1995.)

Results

In 1995, participants primarily used the university UNIX system for their e-mail accounts, except for the few who had commercial or corporate accounts. By 1997, the variety of available tools had increased. 86% of the respondents used e-mail; 74% used the WWW; and 60% used the FirstClass ™ BBS.

Efficacy x Value

A factor analysis of the responses to the survey questions that dealt with reasons for using the Internet (14 items) and barriers/facilitators to using the Internet (11 items) was performed for three subsets of data: (a) 1995 responses (I.T.), (b) 1997 responses (I.T. cohort), and (c) 1997 responses (Non-I.T. cohort). A principal components analysis with Varimax rotation was then performed on the three sets of data. This revealed the general trends and changes over two years and also highlighted the differences between the I.T. and the non-I.T. The results are presented in Tables 2 and 3.

The primary reasons for Internet use: finding information, communicating with colleagues, sharing information, and collaboration (i.e., sharing information to carry out an intentional activity) varied in importance across time and between programs. Note the emphasis on sharing information among the I.T. cohort vs. the emphasis on finding information and collaborating among the Non-I.T. cohort. In contrast, the facilitators to Internet use were remarkably consistent in all cases, with Bandura's efficacy x value accounting for about half the variance.

Table 2. Results of Factor Analysis on Reasons for Use

Survey	1995: I.T.	1997: I.T.	1997: Non-I.T.
Factor 1	Communicate and share information (42% of variance)	Share information (44% of variance)	Find information and collaborate (50% of variance)
Factor 2	Find information (12% of variance)	Communicate (11% of variance)	Share information (11% of variance)
Factor 3	Collaborate (9% of variance)	Collaborate (8% of variance)	Communicate (8% of variance)
Factor 4	Consult with advisor (8% of variance)	Find information (7% of variance)	-

Table 3. Results of Factor Analysis on Facilitators to Use

Survey	1995: I.T.	1997: I.T.	1997: Non-I.T.
Factor 1	Clear benefit and value (33% of variance)	Clear benefit and value (32% of variance)	Clear benefit and value (38% of variance)
Factor 2	Self-efficacy (17% of variance)	Time and access (15% of variance)	Self-efficacy (16% of variance)
Factor 3	Mediated writing proficiency (10% of variance)	Self-efficacy, part 1 (10% of variance)	-
Factor 4	-	Self-efficacy, part 2 (9% of variance)	-

Personal/Cultural Compatibility

In the interviews, students, faculty, and staff alike reported that the e-mail feature of the FirstClass ™ BBS (i.e., CEO) was and will continue to be an efficient means of communication between students and faculty. The faculty consensus was "it's better than voice mail", and students remarked, "I get better response from professors via e-mail than I do by phone calls". Faculty found it convenient to send and receive papers and assignments via e-mail. Students appreciated the more rapid turnaround time that electronic messaging affords. Moreover, responses from the focus group indicated that there was social pressure among some of the learning sub-communities within the school that reinforced the feeling of "If you don't participate, you may find yourself left behind". Both the interviews and the focus group presented evidence that the early adopters tended to be intrinsically motivated, whereas the later adopters often felt extrinsic coercion.

Besides being an accepted and institutionalized part of the school's culture as a handy communication tool, some faculty members predicted that using electronic conferencing and web pages on CEO for distributed learning might prove a viable alternative to traveling long distances to provide classes for geographically dispersed cohorts. At the time the interviews were conducted (spring, 1998), the Administration, Supervision, and Curriculum Development (ASCD) program had eleven electronic conferences on CEO. Their faculty members are actively exploring the use of the WWW to support distance and distributed learning. A few faculty members recently obtained grants to design on-line courses.

Not all faculty and students, however, are early adopters. Early adopters often expressed a good fit between Internet tools and their personal and cultural values. Late adopters voiced concerns about the impact of the Internet on their core pedagogical strategies, indicating that it may not support their vision of learning. Since internal resistance to innovations, especially the use of interactive technologies, tends to change the traditional role of the instructor (Apple Computer, 1995; Yocam, 1998) and his/her core of instructional practice (Elmore, 1996), institutionalization of Internet and WWW tools other than e-mail will most likely take place in fits and starts. A faculty member described her awareness of this resistance:

> *I'm a little bit nervous about the thoughtful use of distributed learning, but I do see that the first and most obvious thing is reaching those audiences that are not otherwise reachable easily. And there's a lot of resistance to that. I'm in big trouble now because I've insisted that next spring when I'm supposed to go to Durango for three weekends [an eight-hour drive from Denver], an equivalent to one of those weekends is going to be distance learning, somehow. They absolutely do not want me to do that!*

Nearly all interviewees noted that there was no incentive system in place for them to adopt Internet and WWW uses other than e-mail. Interview comments made it apparent that it is going to take quite a while until distributed learning – a very different concept from traditional forms of instruction – becomes part of the school's culture.

Finding a Voice and Having Something to Say

In an activity system, the "tool" must have the necessary affordances to enable the actor to carry out an intentional activity – to accomplish an intended outcome. If the tool does not appear to the user to be the most effective means of accomplishing his/her objective, whether due to its inherently unfriendly interface, or to the user's fear of writing to a public audience and leaving an electronic "paper trail", then it will not be used. In this case, if the Internet "tools" do not make communication easier for the user, then all the training in the world will not turn a resister into an adopter.

Students and faculty who are just beginning to experiment with electronic conferencing and online communication sometimes exhibit written communication and lack of mediated writing proficiency. Text-based communication lack social cues, and therefore, may lead to misunderstandings or misinterpretation of the author's intent. Moreover, it is perceived by some learners to be more reflective than spoken interaction. "The very act of assembling one's thoughts and articulating them in writing for a [computer] conference audience appears to involve deeper cognitive processing" (Berge, 1997: 10). This, in turn, may lead to written communication apprehension.

Fishman (1997) found a significant relationship between written communication apprehension and the use of Usenet newsgroups among students who were using a combination of CMC tools in a mediated learning environment called the "Collaboratory". If the network's interface is not particularly user-friendly (as in the older PINE e-mail interface on the university servers), and if students have concerns about their general representational proficiency (the ability to represent abstract concepts in concrete form) or their mediating writing proficiency (writing to an online audience), then these factors could potentially affect the level of use of the network.

This is exactly what Wilson and his colleagues found in the 1995 interviews. It also showed up as the Factor 3 in the 1995 factor analysis of the survey. By 1997, this factor had disappeared from the survey results, but was still flagged by an interviewed student. She alluded to new forms of literacy that needed to be explored and

developed – visual literacy, media literacy, and literacy in terms of the Internet and e-mail – other forms of literacy that she considered appropriate if the school really aspires to be a community of learning. A professor also discussed the additional cognitive skills that are necessary when dealing with on-line text:

> *It's really hard for me to read on a screen. I really want to print things out if there's very much of it and have a hard copy in my hand. What we don't know is the long-term impact of making those kinds of adjustments to the learner. For example, in reading, we learn how to read stories as little kids. We don't know how to read expository text, so that when expository text gets presented to us, it's new, it's different, it's boring We don't have the skills unless those are actively taught to us because the frameworks that we have for reading are about stories.*

This may be one of the reasons why faculty members lagged behind students in publishing on-line documents. Three faculty and eight students who had personal web pages used them to disseminate full-text versions of their publications. Contributors to the school's "Scholarly publications" page, which espouses a clearly stated set of high standards for publication, consisted of nine faculty members (three of whom were UCD students when they first carried out the research on which their publications were based), twenty students, and seven unaffiliated second authors. Another explanatory factor might be faculty members' fear of compromising intellectual property rights; but ownership and copyright issues did not arise in any of the interviews.

A totally different aspect of "finding a voice and having something to say" is the open sharing of promising practices among faculty who have used the Internet and the WWW effectively. Some faculty members are using electronic conferencing, but not all faculty members are aware of the possibilities that this new form of interactive communication and instruction might entail. Faculty meetings generally deal with administrative issues, leaving little time for professors to share innovative instructional strategies that have proved effective with their students. This is beginning to change with the introduction of workshops for honorarium (part time) professors, inaugurated by the University's Office of Teaching Effectiveness (OTE); and with the creation of the new "Teaching and Learning with Technology" (TLT/LTTS) mentoring laboratory for faculty, made possible by a new grant to the School of Education (See Grabinger, paper #199).

Proper Scaffolding

This refers to a support structure that includes a non-judgmental, social support system, one-on-one mentoring relationships, and removal of technical hurdles to the innovation. Existing and proposed supports were divided into two categories: impersonal and personal. Impersonal supports comprised brochures, booklets, on-line tutorials, and other forms of print-based or electronic performance support that do not require one-on-one interaction with a graduate assistant, fellow student, faculty member, or staff member. Personal supports comprised help from graduate assistants, on-line help from the university's network services staff, direct instruction in class, and free workshops conducted by faculty, staff, technically adept students, or other perceived "experts".

Interview participants were asked to suggest improvements to the school's support structure. Survey participants were asked to rank a set of eight supports for training and performance using e-mail and the WWW, with "1" = most useful support and "8" = least useful support. The eight proposed supports were formal classes, brochures, informative booklets, on-line tutorials, paper tutorials, interactive computer demonstrations, individual assistance by graduate students, and workshops. Participants who rated, rather than ranked, the suggested supports, confounded the results in about 5% of the cases.

In 1995, the supports ranked highest by the survey participants were formal classes (ranked #1 by 32% of respondents) and workshops (ranked #2 by 30% of respondents). Booklets were least popular, with over 20% of the respondents ranking them #6 or #8. Individual attention by graduate students was bipolar: 22% of respondents ranked it #8 and 17% of respondents ranked it either #1 or #3. This was worthy of further investigation.

There were significant positive Spearman correlations ($p<.05$) between the self-efficacy factor and the relative rankings of both formal classes (+.026) and individual attention by graduate students (+.029). There was a significant negative correlation ($p<.05$) between the self-efficacy factor and the relative ranking of informative booklets (-.025). This led to the conclusion that respondents who were low in self-efficacy considered personal supports and scaffolding to be relatively useful as compared with impersonal supports such as booklets.

In 1997, formal classes (ranked #1 by 27% of respondents) and workshops (ranked #1 by 32% of respondents) topped the list of preferred supports. Booklets (ranked #8 by 24% of respondents) were still least popular. However, the bipolarity in the ranking for individual attention by graduate assistants had disappeared, with 25% of respondents ranking this personal support as #1. In contrast, on-line tutorials were now bipolar (ranked #2 by 18% and #7 by 19% of respondents). These rankings indicated that the respondents generally preferred personal scaffolding to impersonal supports, but held varying opinions concerning the specific type of support that they would like to see implemented.

Faculty and students alike were often unaware of the range of supports that already existed. For example, the university's network services developed an extensive set of free workshops – exactly the type of 1- or 2-hour workshops that students said they would like to see offered – but students were not aware of them. Brochures, schedules, and job aids explaining various facets of the university's computers and directions for using them were freely available outside the network services office. Copies were also available in the School of Education's computer lab. Again, staff and graduate assistants were not aware of their existence, so they did not publicize them to new users. An important aspect of an activity system – and any system, for that matter – is the fact that for it to function efficiently, information must flow freely throughout the system, to and from all participants. If a support exists, but users are not aware of it (cf. Rogers, 1995, "observability"), then it is like not being there at all!

Recommendations

This study resulted in a set of recommendations for improving access, functionality, training, and technical support; use of communication channels to convey important information about existing support and scaffolding structures; and the use of electronic conferences to enhance and enrich classroom discussions. It also highlighted the need for an incentive system, and for ways that faculty might share promising practices that use the Internet to support instruction.

Based on the results of this study, recommendations for future investigation and development are listed in Table 4. Other colleges and universities that are considering infusing instructional technology into their general education programs (such as PT3 grantees) might find these recommendations applicable, as well.

Table 4. Recommendations

Have better publicity about existing aids and supports, using multiple channels of communication.
Have better communication and collaboration between the School of Education, the university, and the university network services, possibly sharing duties where they overlap.
Develop a flexible schedule of Internet demonstrations or open lab workshops with optional student attendance.
Hire more graduate students in the School of Education computer lab who have the skills and the time to help individual students with specific problems.
Create a permanent position for an in-building technical support person who will be available in person or by telephone when classes are in session.
Consider the possibility of developing on-line tutorials for commonly used Internet tools.
Encourage "show and tell" sessions among faculty members to discuss and share ideas, strategies, and promising practices for Internet use beyond simple e-mail messaging to support teaching and learning.
Encourage students to create on-line research management products and portfolios to serve as models of scholarly products for new students, and to elicit feedback from peers, colleagues, and experts.

Implications for Institutionalization

Based on this study's findings, the use of e-mail will continue to increase because CEO has become a commonly accepted mediating artifact within the norms and conventions of the school. All interviewees and focus group members used CEO regularly in 1997, in contrast with the more sporadic e-mail use in 1995. As members of a commuter campus, students stated that it is more convenient to connect from home or work on a regular basis rather than to travel to campus and pay for parking (which may not even be available!)

Use of the WWW is increasing, and will continue to increase, now that the foremost item on the students' wish list – free ISP service through student fees to the university – has been granted. Students who primarily used CEO were beginning to discover that, contrary to the WWW, a FirstClass ™ BBS does not automatically provide the types of Internet-wide search engines and database tools the they would like. They stated that they would like to increase their access to research-based databases, on-line libraries, collections of legal and medical information -- resources that are freely available on the WWW and that matched their own educational goals. More importantly, there has been a recent influx of out-of-state applicants to the School of Education, who found out about the school's programs via the Web page created by the Internet Task Force, and who are already Internet-enculturated.

As a result of this study, both the School of Education and the university have become more aware that no electronic helpdesk can offer the moral support that new users need as they deal with their personal and task management concerns. There were three notable follow-ons to this study:

- A TLT/LTTS lab was established through a FPSE grant. It exists primarily for the purpose of mentoring faculty in Internet use and other forms of educational technology (See Grabinger, paper #199).

- The university's Office of Teaching Effectiveness (OTE) runs a "Boot Camp for Professors" each summer. This is beginning to gain in popularity and has been particularly successful because it does not interfere with teaching activities during the normal academic year.
- Based on requests for one-on-one scaffolding by faculty as well as students, the OTE inaugurated a new work-study program this summer. A dozen incoming freshmen in September 1999 were paid to take a July 1999 training session known as "Student Instructional Technology Corps" (SITC), where they received instruction that enabled them to serve as I.T. assistants to various academic divisions throughout the university. However, the SITC eventually ran into insurmountable barriers involving early registration and lack of funds for freshman work-study students.

Increased usage will not come without unintended side effects. What is working now may not work in the future. Students with slow modems and insufficient RAM are beginning to feel a sense of frustration with their older hardware platforms. As new users come on board, especially those who are unfamiliar with computer-mediated communication (CMC), they will continue to have problems with modem settings and other software issues. Moreover, as more and more students begin to use their free student accounts for PPP access to the WWW, system capacity will be stressed, leading to carrier drops and busy signals. All of this can be frustrating for new users. Other educational organizations (Sherry, Lawyer-Brook, & Black, 1997) have had to increase their server capacity or purchase additional servers to keep up with increased on-line traffic as new users begin to use the system on a regular basis. Any instructional technology program or educational institution will eventually have to deal with this issue.

Most importantly, linear adoption models such as Rogers' (1995) *Diffusion of Innovations* and Hall and Hord's (1997) CBAM model (in which *time*, rather than *personal/cultural compatibility*, separates early from late adopters) may not apply to learning organizations such as graduate schools. Often, it is the late adopters who have insights into unintended side effects of technological innovations. Moreover, expanded conceptual frameworks that are based on activity theory, systems theory, or complexity theory (see Wilson, Sherry, Dobrovolny, Batty, & Ryder, in press) may provide one with deeper understandings into how individual and organizational learning and change occur over time within institutions of higher education.

References

Apple Computer. (1995). Changing the conversation about teaching, learning, and technology: a report on 10 years of ACOT research [On-line document]. Available: http://www.research.apple.com/go/acot/ACOTResearch.html

Bandura, A. (1982). Self-efficacy mechanism in human agency. American Psychologist, 37 (2), 122-147.

Berge, Z. (1997). Computer conferencing and the on-line classroom. International Journal of Educational Telecommunications, 3 (1), 3-21.

Elmore, R.F. (1996). Getting to scale with good educational practice. Harvard Educational Review, 66 (1), 1-26.

Engestrom, Y. (1996). Interobjectivity, ideality, and dialectics. Mind, Culture, and Activity, 3 (4), 259-265.

Fishman, B.J. (1997, March). Student traits and the use of computer-mediated communication tools: What matters and why? Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, Illinois.

Hall, G.E., & Hord, S.M. (1987). Change in schools: Facilitating the Process. Albany, New York: State University of New York Press.

Rogers, E.M. (1995). Diffusion of Innovations. (4th Edition). New York: The Free Press.

Ryder, M., & Wilson, B. (1996, February). Affordances and constraints of the Internet for learning and instruction. Paper presented at the annual meeting of the Association for Educational Communications and Technology, Indianapolis, Indiana.

Sherry, L. (1998). Diffusion of the Internet within a Graduate School of Education. Ann Arbor, MI: UMI Dissertation Services. Also available: http://www.cudenver.edu/~lsherry/dissertation/

Sherry, L. (1997). A re-analysis of the 1995 TSS e-mail survey [On-line]. Available: http://www.cudenver.edu/public/education/sherry/95survey.html

Sherry, L., Lawyer-Brook, D., & Black, L. (1997). Evaluation of the Boulder Valley Internet Project: A theory-based approach to evaluation design. Journal of Interactive Learning Research, 8 (2), 199-233.

Sherry, L., Myers, & K.M. (1998). The dynamics of collaborative design. IEEE Transactions on Professional Communication, 41 (2), 123-139.

Sherry, L. & the UCD Internet Task Force. (1996). Supporting a networked community of learners. TechTrends, 1 (4), 28-32.

Tikhomirov, O.K. (1981). The psychological consequences of computerization. In J.V. Wertsch (Ed.), The Concept of activity in Soviet psychology (pp. 256-278). Armonk, New York: M. E. Sharpe, Inc.

Wilson, B., Lowry, M., Koneman, P., & Osman-Jouchoux, R. (1994). Electronic discussion groups: Using e-mail as an instructional strategy in a graduate seminar [On-line]. Available: http://www.cudenver.edu/public/education/edschool/email.html

Wilson, B., Ryder, M., McCahan, J., & Sherry, L. (1996). Cultural assimilation of the Internet: A case study. In M. Simonson (Ed.), Proceedings of selected research and development presentations. Washington DC: Association for Educational Communications and Technology.

Wilson, B., Sherry, L., Dobrovolny, J., Batty, M., & Ryder, M. (In press). Adoption of learning technologies in schools and universities. In H.H. Adelsberger, B. Collis, & J.M. Pawlowski (Eds.), Handbook on Information Technologies for Education and Training. NY: Springer-Verlag.

Yocam, K. (1998). Teacher-centered staff development [On-line]. Available: http://www.apple.com/education/k12/staffdev/tchrcenterstaff.html

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